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DOI:

[10.1007/s40273-017-0499-z](https://doi.org/10.1007/s40273-017-0499-z)

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*Document Version*

Peer reviewed version

*Citation for published version (Harvard):*

Husbands, S, Jowett, S, Barton, P & Coast, J 2017, 'How qualitative methods can be used to inform model development', *PharmacoEconomics*, vol. 35, no. 6, pp. 607-612. <https://doi.org/10.1007/s40273-017-0499-z>

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# How qualitative methods can be used to inform model development

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## Acknowledgements

SH was primarily responsible for reviewing the literature and writing the manuscript, with support from SJ, PB and JC. All authors read, edited and approved the final manuscript.

## Abstract

Decision-analytic models play a key role in informing healthcare resource allocation decisions. However, there are ongoing concerns with the credibility of models. Modelling methods guidance can encourage good practice within model development, but its value is dependent on its ability to address the areas that modellers find most challenging. Further, it is important that modelling methods and related guidance are continually updated in light of any new approaches that could potentially enhance model credibility.

The objective of this paper was to highlight the ways in which qualitative methods have been used and recommended to inform decision-analytic model development and enhance modelling practices. With reference to the literature, the paper discusses two key ways in which qualitative methods can be, and have been, applied. The first approach involves using qualitative methods to understand and inform general and future processes of model development, and the second, using qualitative techniques to directly inform the development of individual models. The literature suggests that qualitative methods can improve the validity and credibility of modelling processes by providing a means to understand existing modelling approaches that identifies where problems are occurring and further guidance is needed. It can also be applied within model development to facilitate the input of experts to structural development. We recommend that current and future model development would benefit from the greater integration of qualitative methods, specifically by studying ‘real’ modelling processes, and by developing recommendations around how qualitative methods can be adopted within everyday modelling practice.

## Key Points for Decision Makers:

- The application of qualitative methods to decision-analytic model development has the potential to enhance the credibility of models
- Qualitative methods can inform good practice for the general and future processes of modelling, in addition to being adopted to enhance practices within the development of individual models

- Those working in modelling methods research should consider the benefits that qualitative methods can provide.

## 1.0 Introduction

Despite the increased use of qualitative research in the field of decision-analytic modelling, there is an absence of discussion and guidance on how qualitative methods can be applied. Qualitative methods have been advocated in other areas of health economics [1,2]; however, little has been done to highlight the benefits of using qualitative approaches to inform model development. Undoubtedly economic models have the potential to play a key role in informing healthcare resource allocation decisions [3,4], but there is continued concern around the credibility of current modelling processes [5], leading people to question the validity of results. Published guidance on good modelling practice can help to address such concerns, provided that it is continually updated in light of new approaches [6], and addresses factors threatening the validity and quality of current models. It is therefore important that modelling research seeks to improve existing methods, whilst also paying attention to elements that are most challenging and lacking in good practice [7]. When applied to model development, qualitative methods can offer robust practices for the development of individual models, and identify areas of practice that are particularly problematic, subsequently informing the development of future modelling guidelines.

The aim of this paper is to highlight the benefits of using qualitative research to inform model development, through reviewing existing studies that have used or recommended qualitative methods to enhance model building. This paper does not intend to provide a systematic overview of the current literature, but instead draw the reader's attention to examples of ways in which qualitative methods have been applied. It suggests that qualitative research has been used in two key ways: 1) to understand and inform the general process of future model development, and 2) to inform the development of individual models. The first section of the paper provides an introduction to qualitative research, with the following two sections guiding the reader through the studies reviewed, including discussion of the benefits and some shortcomings of the qualitative approaches mentioned. The latter part of this paper considers the potential future uses of qualitative methods to inform model development, including barriers to implementation.

## 2.0 Qualitative research

Qualitative research describes a range of methodologies designed to generate an in-depth understanding of a phenomenon from the perspective of those involved [8]. It is concerned with gaining rich insight and description, focusing on structures, processes and meanings that underlie the behaviour, event or organisation of interest [9,10]. Qualitative methods are characterised by first-hand and exploratory data collection, using approaches including in-depth interviews, focus groups and observations [11]. These methods are designed to explore people's opinions and experiences, and aim to generate theories and explanations about a phenomenon through the identification and analysis of patterns, concepts and themes within the qualitative data [12,13]. In contrast to quantitative approaches, qualitative inquiry seeks answers to 'how' and 'why' questions, rather than 'how many' and 'how much' [14] (p5). Qualitative findings also aim to preserve the context and detail of a phenomenon, rather than seeking statistical generalisability [15]. The generalisability and validity of qualitative findings can be enhanced through sampling informants who can provide potentially different research perspectives [16], with continued sampling until saturation is reached (i.e. no new themes are emerging from the

data or across different informants/settings) [17]. The next sections outline two ways in which qualitative methods have been applied to inform model development.

### 3.0 Qualitative methods to understand and inform the process of future model development

A number of studies have used qualitative methods to understand modelling practices and produce findings to inform future model development [18–24]. These studies all aimed to explore ‘real’ modelling processes, seeking to understand model development from the perspective of those involved and generate findings aimed at improving modelling methods. Most followed a two-step process of investigation, first using qualitative inquiry as a means to explore current approaches and identify shortcomings, and second to make recommendations aimed at addressing these and enhancing practice. Problems with model development were identified directly through the concerns and suggestions of informants, and on the basis of issues observed by the researcher(s). The outcome of studies was written guidance on specific aspects of model development, or on the entire modelling process.

Kaltenthaler et al. used documentary analysis to review responses of evidence review groups (ERGs) to manufacturers’ model submissions to the National Institute for Health and Care Excellence (NICE) single technology appraisal (STA) process [18]. Qualitative documentary analysis describes a process for evaluating the content of documents, through finding, interpreting and synthesising data into overarching themes [25]. Within their study, the authors identified recurring concerns from the ERGs about model submissions, through coding the reports and clarification letters sent to manufacturers. This research generated a number of suggestions to help manufacturers improve the quality of submissions on the basis of common issues [18]. However, a drawback of the study methodology was that it did not have a clear sampling strategy, selecting the ‘first thirty completed ERG reports’ for review, rather than sampling for variability, for example, by looking at ERG responses over time to see if issues had changed. Additionally, primary qualitative research with ERG members or manufacturers would have permitted deeper insight into why problems were occurring and how they could be addressed.

Similarly using informant perspectives to understand issues with model development, were two related papers that undertook focus groups [19,20], and one study using in-depth interviews with modellers [21]. Both methodological approaches generated rich data through asking informants to describe their modelling practices, and asking questions about where current approaches required improvement. The difference between focus groups and interviews is that, whilst the former generated data on the collective thoughts of informants, the latter produced personal accounts. Focus groups were used to gain consensus on areas in which good practice was needed in the identification of evidence for models, using interaction between participants to generate insight into which aspects required improvement, and achieving agreement on the most pertinent issues by encouraging informants to reflect on the views of others [26,27]. The interview study focused on generating individual accounts of modellers’ processes and reflections on the methods used. The benefit of using interviews was that the depth of informants’ accounts were preserved [28], facilitating the comparison of approaches taken by modellers, and identifying areas where there was inconsistency in the methods undertaken, common issues, or lack of good practice. An advantage of both qualitative methods were the rich descriptions generated, used to

inform the scope and content of the guidance produced, based on informants' methods and suggestions for good practice. All of these studies recruited informants from different backgrounds to enhance the generalisability of the research, including those working in academia and industry. However, the studies had relatively small sample sizes, and only Kaltenthaler et al. [20] reported reaching saturation of the themes generated, suggesting that different issues could have emerged with continued sampling.

Other studies used a triangulation of qualitative methods. Husbands conducted in-depth interviews with modellers, and used non-participant observation and interviews to follow model development by two modelling teams [22,23]. Whilst in-depth interviews facilitated the identification of common issues through comparing modeller accounts, the observations of modelling activities recorded problems occurring in 'real time'. A benefit of using observation was the ability to study interaction between informants [29], which revealed difficulties in communication during structural development, and allowed resulting recommendations to be focused on these more subtle challenges. Squires et al. [24] also used observation and interviews to follow the development of a public health model, whilst also undertaking a focus group with modellers, and using documentary analysis to analyse personal notes from a previous project. The findings from these methods were consolidated for an understanding of what was working well and less well, to inform the development of a conceptual modelling framework [24]. Using these methods in combination enabled the authors to gauge whether their experiences and the thoughts and behaviours of other modellers aligned with issues occurring within actual model development, enhancing the reliability of the topics covered within the guidance. Using triangulation in these studies strengthened the comprehensiveness of findings, facilitating the identification of different problems and allowing resulting guidance to address issues emerging consistently across different approaches [16]. Both studies took a purposive sampling approach, recruiting modellers from different contexts, with Husbands including modellers working internationally. However, Squires et al. only involved five modellers in the focus group, and followed the development of a model within just one academic institution, potentially affecting the generalisability of the resulting conceptual framework. Similarly, increasing the number of modelling processes observed in the work of Husbands could have enhanced the transferability of recommendations.

These studies have highlighted how qualitative methods can be used to inform future model development through identifying areas of difficulty within real model development, and allowing future research and guidelines to be targeted at problems most pertinent to those working in the field.

## 4.0 Qualitative methods to directly inform the development of individual models

Another way in which qualitative techniques have been used to inform model development is through their application to the construction of individual models. Although modelling methods are typically quantitative in nature, some papers have suggested that qualitative approaches can offer appropriate and robust practices for aspects of model development. The following section presents examples from the literature.

Sullivan and Payne [30] and Iglesias et al. [31] discuss the use of Delphi methods as a means to gain consensus and collate experts' views on aspects of a model's design. Delphi seeks agreement in opinion by asking informants to anonymously complete questionnaires in a series of rounds, with the opportunity between each round to revise answers on the basis of feedback on others' responses [32,33]. Sullivan and Payne also

highlighted the use of Delphi to understand where and how there is disagreement and thus uncertainty between experts, and indeed, Iglesias et al suggested that Delphi should be considered as a qualitative approach when used to collate the opinions of experts, rather than simply aggregate responses. Both authors suggested applications of Delphi to model development, including to define the boundaries of a model, in model conceptualisation, and to identify face validity. Providing further detail, Sullivan and Payne stated that a classical Delphi could be used to develop and reach consensus over the care pathways included within a model structure, and where there is no agreement, identify alternative pathways for structural sensitivity analysis. The potential benefit is that the uncertainties within the model structure are identified, and the validity of the model structure is challenged. Using Delphi can also enhance the generalisability of a model, as Delphi permits the input of large numbers of experts, and variations in care pathways and medical practices can be accounted for [30]. Neither paper however, discussed the drawbacks of Delphi, for example that the process can be lengthy, potentially leading to experts withdrawing before it is complete, affecting the validity of results [34]. Another concern is that Delphi forces consensus instead of allowing experts to discuss and elaborate on their views, impacting the validity of responses [34]. However, if Delphi is used in the way described by the authors i.e. as a means to collate rather than reduce perspectives, then this concern could be minimised. Despite both papers offering guidance on potential applications for Delphi, and Iglesias et al. generating guidelines for reporting Delphi methods, detailed methods guidance on using Delphi in model development is needed.

An alternative is the application of focus group methods to inform the conceptualisation of model structure. Similarly to Delphi, focus groups can encourage consensus in decisions around the inputs to a model, through asking participants to reflect on and refine their views in light of others' opinions [35]. Discussions are face-to-face, and a moderator is appointed to ensure that all individuals can contribute [27]. A focus group style approach for model conceptualisation has been advocated within modelling guidelines [36], and Squires et al. [24] have generated guidance advocating the use of stakeholder workshops to conceptualise a model. Squires et al. recommend that discussions between stakeholders be used to make decisions on what should inform structure, and produce diagrammatical representations (concept/causal map) at each stage of structural development. The benefits of focus groups is that they provide an explicit and transparent method for structural development, allowing the decisions behind the inputs, exclusions and iterations of a model structure to be recorded [24,36]. Similarly to Delphi, focus groups can also highlight aspects of disagreement between experts, including where it would be valuable to include or test various perspectives. Due to the lay format of focus groups, it is possible that they could be used to facilitate the involvement of patient representatives, in addition to clinicians and economists. However, a potential drawback is the practicality of organising and running face-to-face discussions with stakeholders, with Squires et al. acknowledging that one-to-one meetings or communication by telephone may sometimes be more suitable.

Finally, Husbands suggested that modellers could apply qualitative techniques to the sampling of clinical experts to inform structural development, based on findings that modellers were typically not recruiting a variety of clinicians, potentially affecting generalisability [22]. Husbands recommended that modellers take a purposive, maximum variation sampling approach, which involves approaching all of those that can give a knowledgeable but potentially different perspective [37]. The authors suggested that modellers could recruit clinicians who treat patients at different points in a clinical pathway, and those working in different locations. A similar sampling approach could be taken to the involvement of patient representatives, aiming to recruit

individuals from different locations to potentially capture variability in practices across different medical centres. Sampling individuals in this way could strengthen the validity and generalisability of model results, and could be applied alongside Delphi or focus group methods. However, there are practical considerations to implementing this method, particularly gaining the input of multiple clinicians with busy workloads.

## 5.0 Future uses of qualitative research in model development

This paper has provided an overview of existing literature using or recommending qualitative methods as a means to enhance model development. The review of studies using qualitative research to understand current methods and make recommendations for future modelling practices has highlighted its potential to identify areas of difficulty, and develop rich guidance based on the thoughts and behaviours of modellers. In terms of future applications, qualitative methods could be used to generate recommendations for modelling practices that are known to be difficult or are underrepresented within modelling guidelines. Areas highlighted as requiring further research within the literature are structural uncertainty and the use of data in structural development [5,7]. Although focusing future work on areas of known difficulty is useful, it is still important to use qualitative methods to explore modelling processes generally, identifying variations in practice and further issues occurring within actual model development. This qualitative approach would be valuable if adopted more widely by those developing modelling guidelines, the advantage being that guidance would be tailored to the needs of modellers, and recommendations informed by the collective good practices of those working in the field. However, a barrier to implementing qualitative research in guideline development is that it is time and resource intensive, requiring the commitment of researchers and the in-depth and sometimes prolonged study of the activities of modellers. Also problematic is that health economists and modellers typically do not receive training in qualitative research, making it difficult to carry out good quality qualitative studies. Indeed, the majority of the studies reviewed in Section 3.0 had issues with sampling, which may have affected the validity and generalisability of the recommendations produced. If a qualitative approach to guideline development is adopted, researchers may first benefit from mentoring and training in qualitative methods, which requires further consideration.

A number of studies reviewed in this paper have advocated the application of qualitative methods to the development of individual models. Collectively these studies suggested that qualitative techniques lend themselves particularly well to facilitating the involvement of experts in structural development, which can enhance model validity and generalisability through accounting for a variety of perspectives. The studies reviewed here advocated qualitative methods to facilitate the involvement of professional stakeholders, but focus groups or Delphi could also be used to involve patients in model conceptualisation, with patient involvement acknowledged as an important area requiring further research [38]. Future work should focus on developing detailed modelling methods guidance for existing qualitative techniques, and consider additional ways in which qualitative methods can be valuable. Despite the advantages associated with the qualitative methods discussed, there appears to have been limited uptake of qualitative practices within modelling guidelines and model development. This may be for a number of reasons, namely that modellers are unfamiliar with qualitative methods, and that applying qualitative methods can be time and resource intensive, for example, in organising and facilitating Delphi panels or focus groups. It is well known that models are typically developed under time and resource constraints and thus using qualitative techniques could increase burden on



modellers. Although no research has been done to evaluate qualitative techniques against any alternatives, it is clear that approaches such as those reviewed offer robust and credible ways of contributing to structural development. Therefore it could be argued that the additional investment required by qualitative methods could be justified through the increased confidence that modellers and their users have in the credibility of completed models. Research to evaluate the benefits of committing additional resources to undertake qualitative methods within model development is needed.

## 6.0 Conclusion

Qualitative methods can be used to inform individual and future model development. This review has shown that qualitative techniques can be applied to model development to explore existing methods and identify where problems are occurring and guidance is needed, and can contribute to the structural development of individual models. This paper has discussed how both applications have the potential to enhance current methods and the validity and credibility of models generally. We suggest that those working in model development, and those looking to undertake research aimed at improving modelling methods consider the opportunities that qualitative methods provide.

Data sharing not applicable to this article as no datasets were generated or analysed during the current study.

### **Compliance with ethical standards:**

**Funding:** The preparation of this review was in part funded by a college studentship obtained by SH through the University of Birmingham.

**Disclosure of potential conflicts of interest:** Samantha Husbands, Susan Jowett, Pelham Barton and Joanna Coast declare that they have no conflict of interest.

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